

**REMARKS**

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. Specifically, Applicants have amended claim 4 to recite that the another protective film-forming agent (1) has properties different than those of the one protective film-forming agent and (2) exhibits an effect of controlling the etching rate to not more than 10 nm/minutes without incorporating the one protective film-forming agent, the one protective film-forming agent and the another protective film-forming agent together controlling etching rate, while maintaining chemical mechanical polishing rate, of the metal film surface, to be the polishing rate of at least 100 nm/minute and the etching rate of not more than 10 nm/minute. Claim 8 has been amended to recite "the" group; in view of this amendment of claim 8, it is respectfully submitted that the objection thereto in Item 1 on page 2 of the Office Action mailed July 16, 2003, has been overcome.

Independent claim 10 has been amended to recite that the second protective film-forming agent has properties different from those of the first protective film-forming agent, and to recite that a combination of the first and second protective film-forming agents controls etching rate, while maintaining chemical mechanical polishing rate, of the metal.

Claim 14 has been amended to recite that a combination of the additive and of the protective film-forming agent controls etching rate, while maintaining chemical mechanical polishing rate, of the metal.

In connection with the present amendments to the claims, note, for example, pages 7-10 of Applicants' specification. As for what is meant by etching rate, note the paragraph bridging pages 10 and 11 of Applicants' specification. As for what is meant

by the chemical mechanical polishing rate, note page 11, lines 6-16, of Applicants' specification.

Initially, Applicants respectfully request entry of the present amendments, notwithstanding finality of the Office Action mailed July 16, 2003. In this regard, it is respectfully submitted that the present amendments address issues newly raised by the Examiner in the Office Action mailed July 16, 2003. Accordingly, it is respectfully submitted that the present amendments do not raise any new issues. In addition, noting portions of Applicants' specification referred to in the foregoing, it is respectfully submitted that the present amendments clearly do not raise any issue of new matter. Moreover, by further defining the present invention to emphasize a further basis in the claims in light of previous arguments by Applicants, and by further defining various aspects of the present invention, it is respectfully submitted that the present amendments materially limit issues remaining in connection with the above-identified application; and, at the very least, present the claims in better form for Appeal. Again noting arguments made by the Examiner in the Office Action mailed July 16, 2003, it is respectfully submitted that the present amendments are clearly timely.

In view of the foregoing, it is respectfully submitted that Applicants have made the necessary showing under 37 CFR § 1.116(c); and that, accordingly, entry of the present amendments is clearly proper.

Applicants respectfully traverse the rejection of claims 5, 6, 13 and 17 under the first paragraph of 35 USC §112, the Examiner contending that these claims fail to comply with the written description requirement, set forth in Item 3 bridging pages 2 and 3 of the Office Action mailed July 16, 2003. Each of the claim rejections under the first

paragraph of 35 USC §112 is based upon use of the language "consisting essentially of" in claims 5, 6, 13 and 17.

Contrary to the conclusion by the Examiner, it is respectfully submitted that the original disclosure supports the presently claimed subject matter, including a composition "consisting essentially of" the recited components. In this regard, attention is respectfully directed to, e.g., the first paragraph on page 6 of Applicants' specification.

This describes that the polishing solution, for metal, makes the etching rate sufficiently low, and can form highly reliable metal film buried patterns while maintaining a high chemical mechanical polishing rate. See also page 21, lines 16-22 of Applicants' specification. Clearly, the present invention defines the nature, and basic and novel characteristics of the present invention.

In view of the description in Applicants' specification of the purpose of the present invention, it is respectfully submitted that the present disclosure is clear as to what would constitute a material change to the basic and novel characteristics of the invention. For example, a material substantially increasing the etching rate, or substantially decreasing the chemical mechanical polishing rate, would materially change the characteristics of Applicants' invention.

In addition, note page 12 of Applicants' specification, describing that the polishing solution as a whole has as essential components the oxidizing agent, the oxidized-metal dissolving agent, the first protective film-forming agent, the second protective film-forming agent and water, further defining components of the polishing solution according to the present invention. In view thereof, and especially in view of the disclosure of the function for the polishing solution and objectives thereof, it is respectfully submitted that Applicants' disclosure as a whole provides a description

which indicates materials which have an adverse effect and would be excluded by the "consisting essentially of" language, and thus provides a description supporting the "consisting essentially of" language.

Reference by the Examiner to PPG Industries, Inc. v. Guardian Industries Corp., 48 USPQ 2d 1351 (CAFC 1998), in connection with the rejection under the first paragraph of 35 USC §112, is noted. However, it is respectfully submitted that even under the guidelines of this case, the original disclosure of the above-identified application satisfies the written description requirement of 35 USC §112, first paragraph, with respect to a solution "consisting essentially of" the recited components. That is, it is respectfully submitted that Applicants make clear in their specification what they regard as constituting a material change in the basic and novel characteristics of the invention. For example, a material which substantially increases etching rate would materially change the characteristics of the present invention. Thus, even under requirements of PPG Industries, Inc. v. Guardian Industries Corp., *supra*, the specification of the above-identified application provides a proper description, within the requirements of 35 USC §112, first paragraph, of a solution consisting essentially of the recited components.

Applicants respectfully submit that all of the claims now presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed July 16, 2003, that is, the teachings of the U.S. patents to Sasaki, et al., No. 5,770,095, and to Kodama, et al., No. 5,733,819, under the provisions of 35 USC §102 and 35 USC §103.

It is respectfully submitted that the references as applied by the Examiner would have neither taught nor would have suggested such a polishing solution for polishing a metal film, as in the present claims, including, inter alia, an additive which is capable of etching the metal film surface at an etching rate of 10 nm/minute or lower, together with the protective film-forming agent which, in combination with the additive, is capable of removing the metal formed surface by chemical mechanical polishing at a polishing rate of at least 100 nm/minute and an etching rate of not more than 10 nm/minute. See claim 3. Note also claims 12 and 15.

Moreover, it is respectfully submitted that these applied references would have neither taught nor would have suggested such polishing solution as in the present claims, wherein the additive includes, inter alia, another protective film-forming agent (1) having properties different from those of the protective film-forming agent recited initially in claim 3, and (2) exhibiting an effect of controlling the etching rate to not more than 10 nm/minute without incorporating the protective film-forming agent initially recited in claim 3, with the protective film-forming agent recited initially in claim 3 and the another protective film-forming agent together controlling the etching rate, while maintaining the chemical mechanical polishing rate, of the metal film surface, to be the polishing rate of at least 100 nm/minute and the etching rate of not more than 10 nm/minute. See claim 4.

Furthermore, it is respectfully submitted that these applied references would have neither taught nor would have suggested such a polishing solution for polishing a metal film surface as in the present claims, including, inter alia, the first protective film-forming agent (additive which is capable of forming a protective film by at least one of physical adsorption and chemical linkage on the metal film) and a (second) protective

film-forming agent, and wherein a combination of these two protective film-forming agents controls etching rate, while maintaining chemical mechanical polishing rate, of the metal. Note claims 10 and 14.

In addition, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested the other aspects of the present invention as in the remaining, dependent claims, including (but not limited to) wherein the protective film-forming agent, recited initially in claim 3, is selected from the group of compounds as in claims 7 and 8; and/or wherein the polishing solution, including the additive and protective film-forming agent which is capable of removing the metal film surface at the polishing and etching rates as set forth in claim 3, is adapted to polish a metal film surface which includes copper or alloys/oxides thereof (see claim 9); and/or wherein the solution consists essentially of the recited components as in claims 5, 6, 13 and 17.

In addition, the undersigned notes the presently submitted Declaration under 37 CFR § 1.132 of Mr. Y. Kamigata, one of the named inventors of the above-identified application. It is respectfully submitted that this Declaration contains evidence (1) rebutting any conclusion by the Examiner that the teachings of U.S. Patent No. 5,770,095 to Sasaki, et al. disclose first and second protective film-forming agents, in its disclosure including aminoacetic and/or amidosulfuric acid; and (2) establishing that the presently claimed subject matter provides unexpectedly better results over compositions of U.S. Patent No. 5,770,095 to Sasaki, et al., containing, inter alia, glycine and/or amidosulfuric acid, rebutting any possible prima facie case of obviousness and further establishing unobviousness of the presently claimed subject matter. This Declaration, being submitted in response to new arguments presented by

the Examiner in the Office Action mailed July 16, 2003, is clearly timely, and should be entered and fully considered presently in the above-identified application, notwithstanding finality of the Office Action mailed July 16, 2003. Accordingly, entry of the enclosed Declaration, and full consideration thereof during further proceedings in connection with the above-identified application, are respectfully requested.

The invention as claimed in the above-identified application is directed to a polishing solution for polishing a metal, particularly suitable for polishing and forming wirings of semiconductor devices.

In recent years, chemical mechanical polishing has been performed in manufacturing semiconductor integrated circuits, particularly in the planarizing of interlayer insulating films and in the formation of metal plugs and formation of buried wirings (for example, in the step of forming multilayer wiring). In a common method for chemical mechanical polishing, a polishing pad is stuck onto a circular polishing surface plate; the surface of the polishing pad is soaked with a polishing slurry containing abrasives; the surface of the substrate on which a metal film has been formed is pressed against the pad surface; and a polishing platen is located in a state in which a preset pressure is applied, so that hills of the metal film are removed by mechanical friction between the polishing slurry and the hills of the metal film. The abrasive in the slurry is a solid abrasive particle or grains.

However, when a conventional polishing slurry contains solid abrasive grains is used, there are problems in which a middle portion of the surface of a buried metal wiring is isotropically corroded to become hollow like a dish (dishing), polishing scratches due to the solid abrasive grains may occur, and a complicated cleaning process is required for removing any solid abrasive grains remaining on the substrate

surface after polishing. Moreover, the initial cost of the solid abrasive grains themselves, and disposal of waste liquid, bring about a high cost. Note the paragraph bridging pages 4 and 5 of Applicants' specification.

In order to avoid the problem of dishing, which is, for example, due to excessive etching (that is, an excessive etching rate) of the metal surface being polished (compare the undesirable etching to the desired polishing), a method making use of a polishing solution which contains an oxidized metal dissolving agent comprised of aminoacetic acid or amidosulfuric acid and benzotriazole has been proposed. However, the benzotriazole has so high a protective film-forming effect that it may cause a great decrease not only in etching rate of the metal, but also in the polishing rate thereof.

Accordingly, it is still desired to provide a polishing solution which avoids the need for solid abrasive particles and which avoids problems of, e.g., dishing and erosion (erosion being, for example, silicon oxide loss from the surface of silicon oxide being polished).

Against this background, Applicants have found that the foregoing problems are avoided through a polishing solution as in the present invention, including, inter alia, protective film-forming agents, and wherein the solution is capable of removing the metal film surface, by chemical mechanical polishing, at a polishing rate of at least 100 nm/minute and an etching rate of not more than 10 nm/minute, and wherein the protective film-forming agents permit the polishing solution to achieve these rates. That is, Applicants have found that a desired polishing (smoothing) effect can be obtained as long as the etching rate is controlled to 10 nm/minute or lower; and thus, Applicants have found a maximum allowable etching rate, to achieve the desired polishing



(smoothing) without, e.g., substantial dishing or erosion. Applicants have also found that by providing a polishing rate of at least 100 nm/minute, together with the etching rate of not more than 10 nm/minute, an effective and efficient polishing rate, while avoiding undesirable etching, is achieved.

In addition, Applicants found that through use of first and second protective film-forming agents as in the present invention, the desired chemical mechanical polishing can be achieved without an unduly large etching rate. That is, Applicants have found that by use of the combination of both the first protective film-forming agent and the second protective film-forming agent as in various of the present claims, with the combination performing functions of controlling the etching rate while maintaining the chemical mechanical polishing rate, as set forth, for example, in claims 4, 10 and 14, undesired etching can be controlled (e.g., reduced), while maintaining a desired high rate of polishing. See the paragraph bridging pages 8 and 9 of Applicants' specification.

That is, Applicants have discovered that by use of the first protective film-forming agent in combination with the second protective film-forming agent, the etching rate can be controlled to be sufficiently low while the chemical mechanical polishing rate does not substantially decrease, even when the first protective film-forming agent is added in a low concentration. Through use of the polishing solution containing both the first and second protective film-forming agents, desired polishing rates can be achieved, without undesired etching, and without the need for solid abrasives.

In addition, Applicants have found specific materials for each of the first and second protective film-forming agents, which materials in combination achieve a desired polishing rate, while avoiding an unduly large etching rate.

It is emphasized that an aspect of the present invention has been achieved by discovery by Applicants of use of a combination of two protective film-forming agents, having different properties, the agents in combination maintaining the chemical mechanical polishing rate while reducing the etching rate. The unexpectedly better results achieved through use of the combination of first and second protective film-forming agents as recited in various of the present claims, and the advantages thereof, would have neither been disclosed nor would have been suggested by the teachings of the applied references.

Sasaki, et al. discloses a polishing agent and polishing method, for use in micro-processing a substrate (for example, a semiconductor, in a semiconductor device manufacturing process). The polishing agent includes a chemical agent responsible for forming a protection film on the surface of the substrate to be polished by reacting with the material containing a metal as a main component. See column 2, lines 7-15. Sasaki, et al. discloses that it is preferred that the polishing agent contain an aminoacetic acid and/or amidosulfuric acid, an oxidizing agent, water and benzotriazole. This patent discloses that when benzotriazole is not added, a polishing rate as high as approximately 250nm/min and an etching rate as high as approximately 45nm/min occurs; and as the amount of benzotriazole increases, both the polishing rate and etching rate decrease exponentially.

Noting particularly that Sasaki, et al. refers to a high etching rate when a polishing rate as high as approximately 250nm/min is described, it is respectfully submitted that this patent does not disclose, nor would have suggested, such a polishing solution as in the present invention, capable of removing the metal film

surface by chemical mechanical polishing at a polishing rate of at least 100nm/min and an etching rate of not more than 10nm/min. Note, for example claim 3.

In addition, it is emphasized that Sasaki, et al. describes a technique, as described previously, containing a first film-forming agent (e.g., benzotriazole) with, inter alia, aminoacetic acid and/or amidosulfuric acid. As is clear from the presently submitted Declaration, such a polishing agent as in Sasaki, et al. does not describe nor would have suggested the combination of protective film-forming agents, particularly wherein the combination of film-forming agents control etching rate, while maintaining chemical mechanical polishing rate, of the metal film surface, and advantages thereof, as in the present invention.

The contention by the Examiner that Sasaki, et al. discloses a solution inherently capable of removing metal film surface by chemical mechanical polishing at a polishing rate of at least 100nm/min and an etching rate of not more than 10nm/min is respectfully traversed. As seen in the enclosed Declaration, clearly the polishing agent of Sasaki, et al. does not use all of the same components as claimed in the present claims, the polishing agent in Sasaki, et al. not including the protective film-forming agent recited in claim 3, or the (second) protective film-forming agent, or combination of first and second protective film-forming agents.

Moreover, it is respectfully submitted that the Examiner has not provided any proper basis for concluding inherency, particularly in light of the evidence in the enclosed Declaration showing that polishing agents containing aminoacetic and/or amidosulfuric acids would not inherently achieve etching and chemical mechanical polishing rates as in the present claims. Clearly, the enclosed Declaration rebuts any conclusion by the Examiner concerning inherency. Moreover, noting that the

Declaration establishes that the aminoacetic and/or amidosulfuric acids do not qualify as agents corresponding to the, e.g., second protective film-forming agent according to the present invention, it is respectfully submitted that Applicants have clearly rebutted any conclusion by the Examiner that Sasaki, et al. discloses a solution with the same components as claimed in the above-identified application.

In addition, it is again emphasized that Sasaki, et al. discloses incorporation of benzotriazole to "exponentially decrease" both polishing rate and etching rate. It is respectfully submitted that the function of the solution in Sasaki, et al. is different from the polishing solution according to the present invention and would not provide advantages achieved according to the present invention. Specifically, it is respectfully submitted that Sasaki, et al. would have neither have disclosed nor would have suggested a solution providing relatively high polishing rate and relatively low etching rate, and advantages thereof as discussed in the foregoing.

It is respectfully submitted that the additional teachings of Kodama, et al. would not have rectified the deficiencies of Sasaki, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art. Kodama, et al. discloses a polishing composition useful for polishing semiconductors, photomasks, substrates for various memory hard disks and various industrial products such as synthetic resins or parts thereof. The composition includes silicon nitride fine powder, water and an acid, this patent disclosing that the polishing composition has a high rate for polishing a silicon dioxide film. See column 3, lines 62-65. This patent further discloses that in the preparation of the polishing composition, various conventional additives may further be added, and that typical examples of such additives include silicon dioxides, celluloses, water-soluble alcohols, surfactants,

organic polyanion type substances, inorganic salts, water-soluble polymers and aluminum oxides. Note column 6, lines 29-49.

Initially, it is noted that Kodama, et al. is concerned with a polishing solution containing abrasives; and as applied by the Examiner, polishes a silicon dioxide film with high selectivity relative to the rate of polishing a silicon nitride film. It is respectfully submitted that one of ordinary skill in the art concerned with in Sasaki, et al., as applied by the Examiner, for polishing a conductive film, would not have looked to the polishing composition of Kodama, et al. for polishing an insulating material such as silicon oxide. Particularly in view of the different materials polished and different polishing techniques in the two applied references, including wherein abrasives are avoided in Sasaki, et al, it is respectfully submitted that one of ordinary skill in the art concerned with in Sasaki, et al. would not have been motivated to look to the teachings of Kodama, et al.

In any event, assuming, arguendo, that the teachings of Sasaki, et al. and of Kodama, et al. were properly combinable, such combined teachings would have neither disclosed nor would have suggested the presently claimed subject matter, including the combination of protective film-forming agents as in the present claims and function of this combination, and advantages achieved thereby as discussed in the foregoing.

Moreover, attention is again directed to the enclosed copy of the Declaration of Y. Kamigata, one of the named inventors in that above-identified application. It is respectfully submitted that this Declaration uses various examples of combinations of amidosulfuric acid and/or glycine (an aminoacetic acid), and together with results within the scope of the present invention, shows that the solutions (1) – (4), containing glycine and/or amidosulfuric acid, do not achieve the unexpectedly better results achieved

according to the present invention (Items 14-16 on pages 5 and 6 of the enclosed Declaration).

Moreover, attention is respectfully directed to the present claims reciting a polishing solution "consisting essentially of" the recited components. As can be appreciated from the results using solutions (1) – (4) of the enclosed Declaration, use of a solution containing amidosulfuric acid and/or glycine provides a disadvantageously low chemical mechanical polishing rate and/or disadvantageously high etching rate. Particularly in view of the results in this Declaration, it can be seen that these materials are excluded from the "consisting essentially of" language of the present claims. Particularly with respect to claims reciting solutions "consisting essentially of" the recited components, of the present claims, it is respectfully submitted that the teachings of Sasaki, et al., including glycine and/or amidosulfuric acid, would have taught away from aspects of the present invention.

Attention is also respectfully directed to the statement by Mr. Kamigata in Item 5 on page two of the enclosed Declaration, that glycine and/or amidosulfuric acid do not qualify as a second protective film-forming agent as in the present invention. Particularly together with the unexpectedly better results shown for compositions according to the present invention, as discussed in the foregoing, and in light of this statement by Mr. Kamigata, it is respectfully submitted that the teachings of Sasaki, et al. would have neither disclosed nor would have suggested, and, in fact, would have taught away from, the presently claimed subject matter.

In view of the foregoing comments and amendments, entry of the present amendments, and reconsideration and allowance of all claims remaining in the application, are respectfully requested.

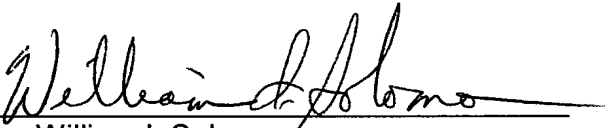
Application No.: 09/976,001

Docket No.: 566.39787CX1

To the extent necessary, Applicants petition for an extension of time under 37 CFR § 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to the Deposit Account No. 01-2135 (Docket No. 566.39787CX1), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

ANTONELLI, TERRY, STOUT & KRAUS, LLP

By   
William I. Solomon  
Reg. No. 28,565

WIS/sjg/dlt

1300 North Seventeenth Street, Suite 1800  
Arlington, Virginia 22209  
Telephone: (703) 312-6600  
Facsimile: (703) 312-6666